REMARKS

Priority document

A certified copy of the priority application SG 2000003691-3 has been filed under separate cover. The Examiner is requested to acknowledge receipt of the certified copy of the priority document in the next communication from the Office.

Claims considered

The Office Action of December 20, 2002 presents the examination of claims 1-19, 21, 23, 34 and 35. Claims 20 and 22 were indicated as canceled in Applicants' Remarks in the paper of November 27, but there was no instruction to cancel them presented. Such instruction is provided herein to clarify the record. Claims 24-33 are pending, but presently withdrawn from consideration. This paper adds claim 36 for consideration.

Support for new claim 36 is provided by Example 2 at page 12 of the specification.

Restriction

The Examiner indicates that claim 22 (now claim 23 amended to independent form), and claims dependent thereon, recite method steps distinct from those of the elected claims 1-19, 21, 23, 34 and 35, and therefore additional, undue search burden is imposed by

Applicants' request that claims 24-33 be examined in the present application.

Applicants submit that the claims 25-33 are directed to products made by the processes currently under examination and are dependent from claim 23, presently being examined. The product claim 24 is of course a generic product, per se. The invention of claim 24 is related to the invention of the claims under examination as a product and a method (e.g. claim 1) for making it. To the degree that the Examiner argues that restriction is proper because methods recited in claim 23 are different from those recited in other claims, the Examiner is reminded that claim 1 is generic to the methods recited in claim 23. Also, claim 23 has been amended to recite specifically the methods of claims 1 and 34 (and new claim 36) all presently under examination. Thus, the Examiner's reasons for maintaining the restriction requirement are overcome. Applicants accordingly request rejoinder of claims 24-33 to the present application.

Claim objections and rejections under 35 U.S.C. § 112, second paragraph

Claims 6, 7, 11, 13, 14, 34 and 35 are objected to because the terms "viologen" and "viologen salt" are used interchangeably. Claims 1-19, 21, 23, 34 and 35 are rejected under 35 U.S.C. § 112, second paragraph for various reasons presented on pages 3-5 of the

Office Action. Applicants have amended the claims to consistently use the term "viologen salt" and to adopt the language suggested by the Examiner in his description of interpretation of the claims for examination. Accordingly, the stated objections and rejections of the claims for lack of clarity of language are overcome.

Rejections over prior art

The Examiner rejects all of the claims of the application under 35 U.S.C. § 103(a) over various combinations of references and "well-known chemistry". Each of these rejections are addressed below.

Claims 1, 2, 10, 11 and 17 stand rejected as being unpatentable over Mikhael '017 in view of Porter '621. This rejection is respectfully traversed. Reconsideration and withdrawal thereof are requested.

In particular, Applicants submit that the Examiner fails to establish a proper case of *prima facie* obviousness of the claimed invention. There is no motivation to combine the cited references in the manner suggested in making the rejection nor expectation of success in achieving the invention by making the combination.

Mikhael is cited as teaching the contacting of a polymeric material that can be doped with an organic electron acceptor, such as quinone. Mikhael only teaches the quinone acceptor and does not disclose or suggest any viologen salt. The Examiner admits as much

and cites Porter as showing the equivalence of a quinone and a viologen salt.

Porter describes methods for oxidative splitting of water to form hydrogen. Thus, while quinones and viologen salts might be equivalent for such purpose, there is no suggestion in Porter that quinones are equivalent to viologen salts for purposes of oxidatively doping a polymeric material. Also, Porter does not establish any expectation by one of ordinary skill in the art that a viologen salt will function as an oxidative dopant of a polymeric material. Thus, Mikhael cannot properly be combined with Porter to assert obviousness of the claimed invention and the rejection fails and should be withdrawn.

Claims 1, 2, 7-11, 15, 17-19 and 23 stand rejected as being unpatentable over Afzali-Ardakani '370 in view of Porter and Rembaum. This rejection is respectfully traversed. Reconsideration and withdrawal thereof are requested.

Again the Examiner fails to establish a proper case of *prima facie* obviousness. Afzali-Ardakani '370 discloses making a mixture of a polymeric material, exemplifying polyaniline and a quinone or the compound shown in Figure 2 of the reference, in a solvent, thereby forming a charge transfer complex. Rembaum is cited for the elements of dependent claims reciting particular reaction conditions or the presence of air or absence of solvent (claim 19). This rejection fails for the same reason as the first

rejection above; that is, the combination of Afzali-Ardakani with Porter does not suggest that a viologen salt can be used for oxidative doping of a polymeric material. Rembaum does not remedy this deficiency. Thus, the combined references do not describe or suggest the invention every element of the invention. Alternatively, the required motivation to combine Afzali-Ardakani with Porter and Rembaum in the manner the Examiner does is lacking. Thus, the instant rejection fails and should be withdrawn.

Claims 3-6 and 35 stand rejected over Afzali-Ardakani, Porter, Rembaum and Beratan. The disclosures of Afzali-Ardakani, Porter and Rembaum are explained above. Beratan is cited for suggesting that the reaction can be performed upon a substrate. However, Beratan does not remedy the deficiencies of the combination of Afzali-Ardakani and Porter to suggest the basic invention. Thus this rejection also fails and should be withdrawn.

Furthermore, and especially relevant to claims 35 and 36, the Examiner asserts that the chemistry of grafting of vinyl alkyl groups and of quaternizing nitrogen is well-known. The Examiner further cites Moshtev and Spence as evidence that charge transfer complexes can be used on low density polyethylene substrates. None of these assertions address the issue of how general reactions for grafting and quaternizing should be applied to the specific problem of grafting viologen on a substrate nor suggest that such should be done.

Examples 1 and 2 of the specification demonstrate that the manner in which the viologen moiety is introduced can have a substantial effect on the resultant conductivity of the polymeric material. The difference between Example 1 and Example 2 is that in Example 1, a vinyl benzyl chloride grafted film is reacted sequentially with 4,4' bipyridine and benzyl chloride, whereas in Example 2, the grafted film results from the reaction of an equimolar mixture of 4,4' bipyridine and p-xylene dichloride with the vinyl benzyl chloride grafted film. In Example 2, an increased amount of viologen salt is ultimately grafted, as a longer viologen polymer chain results. The ultimate result seems to be more effective interaction of the viologen polymer with polyaniline, resulting in 1 to 2 orders of magnitude higher conductivity. (See, Figure 1 of the application.) Thus, the invention as claimed also provides results not expected by one of ordinary skill in the art that rebuts any *prima facie* case of obviousness that is deemed established by the Examiner.

Claims 12-14 and 16 stand rejected over Afzali-Ardakani, Porter, Rembaum and Inata '062. Inata is cited for disclosure of a polymeric viologen dihalide salt. Again, the primary combination of Afzali-Ardakani, Porter and Rembaum fails to disclose or suggest the primary invention and these references cannot be properly combined in the manner suggested by the Examiner. Inata does nothing to address this basic failure to establish *prima facie*

obviousness of the invention and so this rejection fails also and should be withdrawn.

Claims 34 and 21 stand rejected over Afzali-Ardakani, Porter, Rembaum and Allemand '379. The disclosures of Afzali-Ardakani, Porter and Rembaum are explained above. Allemand is cited for disclosure of how to make the polyaniline substrate (step (i) of claim 34). The Examiner relies upon "well-known chemistry" to provide the elements of steps (ii) and (iii) in claim 34. This rejection fails again because the combination of Afzali-Ardakani and Porter fails to establish *prima facie* obviousness of the basic invention (oxidative doping using a viologen salt) and the additional references do not remedy this deficiency. Furthermore, as explained above, the instant specification provides evidence that the claimed methods provide a polymeric material that has conductivity that is far better than one of ordinary skill in the art would expect given "well-known" chemistry for making such a material.

Applicants submit that the present application well-describes and claims patentable subject matter. Withdrawal of the standing rejections and allowance of the present claims is requested.

Should there be any outstanding matters that need to be resolved in the present application, the Examiner is respectfully requested to contact Mark J. Nuell (Reg. No. 36,623) at the telephone number of the undersigned below, to conduct an interview

in an effort to expedite prosecution in connection with the present application.

If necessary, the Commissioner is hereby authorized in this, concurrent, and future replies, to charge payment or credit any overpayment to Deposit Account No. 02-2448 for any additional fees required under 37 C.F.R. § 1.16 or under 37 C.F.R. § 1.17; particularly, extension of time fees.

Respectfully submitted,

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VERSION WITH MARKINGS TO SHOW CHANGES MADE

IN THE CLAIMS:

Claims 20 and 22 have been cancelled.

The claims have been amended as follows:

1. (Twice Amended) A method for preparing an electrically conductive polymeric material, comprising

a) contacting a polymeric material [capable of exhibiting electrical conductivity upon oxidative doping] with a viologen salt to form a pre-doped composition, wherein said polymeric material is capable of exhibiting electrical conductivity upon oxidative doping; and

b) irradiating the pre-doped composition with electromagnetic radiation, thus producing an electrically conductive polymeric material.

4. (Amended) The method according to claim 3, wherein the viologen salt is grafted onto a suitable substrate utilizing a heat and/or UV-induced treatment to form a viologen salt-bearing substrate.

5. (Amended) The method according to claim 3, wherein the viologen salt is formed in situ in contact with the [polymer] polymeric material.

6. (Amended) The method according to claim [1]3, wherein a - surface of the viologen salt-bearing substrate is partially or completely coated with the polymeric material.

7. (Amended) The method according to claim 1 wherein the [polymer] polymeric material is contacted with the viologen salt by mixing the polymeric material and the viologen salt prior to forming a coating or film [of the polymeric material in situ] of the mixture.

8. (Amended) The method according to claim 1 wherein a coating of the polymeric material is deposited on a suitable substrate to form a polymer-coated substrate.

9. (Amended) The method according to claim 8, wherein the viologen salt is deposited on the polymer--coated substrate to form a substrate coated with polymer and viologen salt.

11. (Amended) The method according to claim 1 wherein at least one of the 1,1'-substituents of the viologen salt are independently selected from an alkyl group or a benzyl group.

13. (Amended) The method according to claim 12, wherein the viologen salt moiety is present in the backbone of the[polymer] polymeric viologen salt.

14. (Amended) The method according to claim 12, wherein the viologen salt moiety is present as a side chain of the[polymer] polymeric viologen salt.

21. (Amended) The method according to claim 34 wherein vinyl benzyl halide is used.

23. (Twice Amended) An electrically conductive polymeric article [prepared according to the method of claim 1 or 35]

comprising an electrically conductive polymeric material prepared by (I) a method comprising:

a) contacting a polymeric material capable of exhibiting electrical conductivity upon oxidative doping with a viologen salt to form a pre-doped composition; and

b) irradiating the pre-doped composition with electromagnetic radiation, thereby obtaining an electrically conductive polymeric material;

or by (II) a method comprising:

a) providing

a vinyl alkyl halide grafted low density polyethylene film substrate;

an alkyl halide; and

4,4'-bipyridine;

b) contacting the grafted film substrate with the 4,4'-bipyridine for a time sufficient to permit reaction therebetween;

c) subsequently contacting the modified grafted film substrate with the alkyl halide for a time sufficient to permit the formation of a viologen grafted film; and

d) coating the viologen salt-grafted film with polyaniline to form a polyaniline-coated film; and

e) exposing the polyaniline-coated film to near-ultraviolet radiation; thereby obtaining an electrically conductive polymeric material.

or by (III) a method comprising;

a) providing a vinyl benzyl grafted film substrate;

b) reacting the vinyl benzyl grafted film with an equimolar mixture of 4,4' bipyridine and p-xylene dihalide to form a viologen salt-grafted film;

c) coating the viologen salt-grafted film with polyaniline to form a polyaniline-coated film; and

d) exposing the polyaniline-coated film to near-ultraviolet radiation;

thereby obtaining an electrically conductive polymeric material.

34. (Amended) The method according to claim 9 wherein the [viologen coated polymeric material] substrate coated with polymer and viologen salt is formed by a method comprising:

a) providing a low density polyethylene film substrate; a solution of aniline or pyrrole; ammonium persulfate; a vinyl alkyl halide or vinyl benzyl halide; an alkyl halide; and 4,4'-bipyridine;

b) immersing the polyethylene film substrate into the solution of aniline or pyrrole and ammonium persulfate for a period sufficient to form a polymeric coating on the substrate;

c) contacting the coated substrate with the vinyl alkyl halide or vinyl benzyl halide;

d) subjecting the mixture to UV or near UV irradiation for a time sufficient to form a vinyl alkyl halide or vinyl benzyl halide grafted substrate; and

e) forming the viologen on the vinyl alkyl halide or vinyl benzyl halide grafted substrate via reaction with 4,4' bipyridine and an alkyl halide.

Claim 36 has been added.